



Mitigation Assessment Team Report

Midwest Floods of 2008 in Iowa and Wisconsin

Building Performance Observations, Recommendations,
and Technical Guidance

FEMA P-765 / October 2009



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MIDWEST FLOODS of 2008 & IN IOWA & WISCONSIN

In response to the 2008 Midwest floods, the Federal Emergency Management Agency (FEMA) deployed a Mitigation Assessment Team (MAT) to evaluate and assess the damages caused by the riverine flooding in Iowa and southern Wisconsin. This report documents the MAT's observations, conclusions, and recommendations on the performance of buildings and other structures impacted by the flooding. The MAT included FEMA Headquarters and Regional Office staff, representatives from other federal agencies and academia, and experts from the design and construction industry.

The conclusions and recommendations in this report are intended to provide decision makers with information and technical guidance that can be used to reduce future flood damage.



Downtown Cedar Rapids, Iowa

Midwest Floods of 2008 in Iowa and Wisconsin

Building Performance Observations,
Recommendations, and Technical Guidance

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MIDWEST FLOODS *of* 2008 & IN IOWA & WISCONSIN

Executive Summary

In June 2008, much of the midwestern United States received over 12 inches of rainfall as several storm systems sequentially impacted the region. The Midwest had experienced wet conditions for several months prior to the precipitation experienced in June; therefore, the June rains fell upon saturated soils resulting in runoff that directly flowed into streams. Resulting stream depths reached historic highs across the Midwest, particularly in many areas of Iowa and southern Wisconsin.

The Federal Emergency Management Agency (FEMA) Mitigation Directorate deployed a Mitigation Assessment Team (MAT) to Iowa and Wisconsin. The purpose of the MAT was to assess damages to residential and commercial buildings and critical facilities as a result of the 2008 Midwest floods. This report presents the MAT's field observations, a general assessment of mitigation programs within FEMA and their application in Iowa and Wisconsin, and subsequent conclusions and recommendations.

Overall Impact of the 2008 Midwest Floods

In Iowa, numerous communities experienced flood crests exceeding historic levels, and some areas flooded well outside of the 1-percent-annual-chance floodplain (also known as the 100-year floodplain). Billions of dollars in damage occurred as homes, businesses, and critical facilities were inundated. In Cedar Rapids, a flood crest more than 12 feet higher than the previous record flooded areas well outside of the 1-percent-annual-chance floodplain, inundating an area of over 9 square miles. In Iowa City, floodwater affected residential neighborhoods, the University of Iowa campus, and other areas.

In Wisconsin, the Rock, Kickapoo, and Baraboo Rivers experienced flooding above record flood stage at multiple locations, causing extensive damage. As homes and roads flooded, residents were forced to evacuate. Sanitary sewer systems experienced high inflow and infiltration, and sewer backups were reported in many critical facilities. Several flooded manufacturing facilities were forced to lay off workers.

Information provided in this report illustrates the extent of ground saturation prior to and during the spring months, the level of precipitation measured during the month of June, and the counties in Iowa and Wisconsin that subsequently received federal disaster declarations. The report also includes timelines of the flooding in Iowa and Wisconsin, outlining and detailing key events in each state along with the estimated flood recurrence interval for several locations visited by the MAT. The field observations detail how the majority of the areas visited experienced a flood that exceeded the 1-percent-annual-chance, and several locations even exceeded the 0.2-percent-annual-chance flood (also known as the 500-year flood).

Damage Assessment Observations

Several types and causes of flooding occurred during the 2008 floods, including:

- Greater than expected river crests and inundation areas
- Backup through storm and sanitary sewers
- Underground tunnel flooding
- High-velocity flows

Thousands of homes and facilities that were prepared for one type or cause of flooding were impacted by another.

The damage to both new and existing single- and multi-family residences were evaluated. Although most of the damage resulted from slowly rising inundation, damages in a few locations were the result of high-velocity flows, particularly in or near the floodway and/or near breached or overtopped levees. The MAT also observed several examples of residential elevation and acquisition projects funded through FEMA's Hazard Mitigation Assistance programs. Acquisition projects, in particular, were noted for their effectiveness in avoiding damages to property and the potential for loss of life.

Damages observed at critical and commercial facilities were primarily related to architectural (non-structural) components, interior finishes, electrical systems, and mechanical systems rather than structural damages. From the exterior, the damages appeared limited; however, several of these structures experienced significant interior damage, which required replacement of most interior components and led to significant repair costs and extensive functional down time. The MAT observed that the performance of utility and water treatment facilities varied based upon the level of flooding, and most locations experienced damages as a result of exposures and vulnerabilities of critical functions.

The following representative types of damages were observed:

- The most common form of structural damage to residential buildings was the failure of foundation walls, especially those constructed from unreinforced masonry. Foundation failures were caused, in most cases, by hydrostatic forces and, in some cases, by hydrodynamic forces.
- Many residential buildings lacked sufficient openings in the foundation walls. In residential buildings that did have openings in their foundation walls, the openings were often too high or were obstructed.
- Critical facilities were damaged not only by rising floodwater but also by water entering through below-grade openings including access tunnels from adjacent parking garages and connecting buildings, utility tunnels, and sewer systems.
- Development in the floodplain and other activities, such as placing unanchored propane tanks and houseboats in the floodplain, led to damaging sources of debris as floodwater rose.

Throughout the field investigations, the MAT noted a lack of new construction (houses built over the last 10 years) in the 1-percent-annual-chance floodplain. Although encouraging in terms of floodplain management and losses avoided, it made it difficult to evaluate what the effectiveness of new building codes and construction techniques would have been under the 2008 flooding conditions.

Recommendations

The recommendations in this report are based on the observations and conclusions of the MAT. They are intended to assist the States of Iowa and Wisconsin and their communities, businesses, and individuals in the reconstruction process; and to help reduce future damage and impacts from similar flood events. The following recommendations are presented in further detail in Chapter 7:

- Basements in the Special Flood Hazard Area (SFHA) should be removed if the house is substantially damaged and the community is not approved for basement exceptions. Consideration should be given to filling in the basement when rebuilding, reinforcing foundation walls during repairs, and conducting community outreach to alert homeowners to the hazard involved in prematurely pumping water out of their basements. Basements in houses located outside the SFHA should also be considered for removal if there is a potential for flooding.

- The importance of continuous load paths with regard to foundations should continue to be emphasized as this is important in properly securing existing buildings that are being elevated on new foundations. In addition, local officials must enforce opening requirements in foundation walls in accordance with published FEMA guidance and minimum National Flood Insurance Program (NFIP) requirements.
- Pre-disaster planning should be conducted by local officials to prepare for increased inspection workload following a flood event.
- Elevation, as it relates to new construction, should be considered and freeboard requirements should be adopted for additional protection. Local communities should also consider the adoption of cumulative substantial damage clauses for substantial improvements.
- Critical facilities should be located outside the 0.2-percent-annual-chance flood hazard area. If this is not possible, equipment and utilities in exposed facilities should be protected to the 0.2-percent-annual-chance flood level. Systematic reduction of inflows from major users should be considered for facilities such as wastewater treatment facilities. Staging of emergency equipment (such as pumps, generators, fuel, etc.) should be planned for locations outside of mapped flood hazard areas.
- Mitigation grant programs should continue to be utilized to the greatest extent possible. Acquisition projects and relocation projects were seen to be highly effective mitigation techniques.
- Wise floodplain management practices should continue to evolve and should place stronger emphasis on flood risk communication, promotion of the NFIP's Community Rating System, reduction of debris sources in the floodplain, creation and support of locally operated programs that fund mitigation projects, and promotion of flood insurance.



MIDWEST FLOODS *of* 2008 & IN IOWA & WISCONSIN

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